Television Watching and Risk of Obesity in American Adolescents

Martin J. Atherson and James Metcalf

Abstract

A large national database (U. S. Centers for Disease Control and Prevention [CDC], 2001) was analyzed for age, sex, race/ethnicity and television viewing among American adolescents aged 12-18 years. Body Mass Indices (BMI) were calculated from self-reported height and weight. Ninety-fifth percentile and above was classified as obese; <95th percentile was classified as non-obese. After controlling for age, sex and race, odds ratios were calculated for obesity and hours/day of television viewing on an average school day. Five or more hours of television viewing on an average school day roughly doubles the risk of obesity. This holds for both males and females. Moreover, these data show a linear trend toward obesity as daily television viewing increases. These data confirm – at the national level– the earlier regional studies linking television viewing to obesity. Health educators may now consider television viewing as a significant risk factor for adolescent obesity.

There is growing interest among health educators concerning modifiable risk factors for obesity in youth. The American Academy of Pediatrics[1] recognizes television viewing as one such avoidable risk factor for obesity among adolescents, as well as other health outcomes including substance abuse, physical violence and poor body image. Moreover, a recent investigation[2] found a direct association between television viewing and the risk of obesity in pre-school-aged children. Obesity, endemic among American adolescents, appears to occur among children as young as age two.

To measure the direction and magnitude of effects on adolescent obesity risk due to television viewing, we analyzed survey response data from the national Youth Risk Behavioral Survey (YRBS) for 2001. The contribution of this study is to enhance the empirical database linking modifiable risk factors for adolescent obesity risk using nationally representative behavioral risk data in which television viewing is self-reported by adolescent respondents with respect to duration and intensity of actual viewing.

Obesity is of interest to health educators because of its association with the onset, severity, and progression of several important diseases, including diabetes[3], heart disease[4], hypertension[5] and clinical depression[6]. According to the Surgeon General[7], the prevalence of obesity "has nearly tripled for adolescents in the past two decades" resulting in hypertension and hypercholesterolemia occurring "with increased frequency in overweight children and adolescents compared to children with a healthy weight."

The relationship between television viewing and obesity in adolescents appears to be strengthened by its dose-dependency; in other words, increasing time spent watching television among adolescents appears to increase their risk of obesity. Data obtained from cycles II and III of the National Health Examination Survey[8] showed that "…the prevalence of obesity increased by 2% for each additional hour of television viewed."

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These data were both cross-sectional and longitudinal, increasing the consistency and "cause-effect nature" of the obesity estimates obtained by the researchers.

This evidence was corroborated in two recent investigations based on national surveys of health and nutrition: The first[9] used data from Continuing Survey of Food Intake for Individuals (CSFII) 1994-1996 and 1998, and the National Health and Nutrition Examination Survey III (NHANES). The respective authors concluded that "In both children and adolescents, television viewing was markedly associated with BMI…" The second[10] showed that the prevalence of adolescent obesity increased from the lowest rate among children watching one hour of television per day to the highest rate among children watching four or more hours per day.

Several regional studies have also demonstrated the efficacy of interventions aimed at decreasing television watching in order to decrease the risk for obesity among adolescents. Robinson[11] provided children in the San Jose region a 6-month program showing them how to reduce the amount of time they spend watching television or playing video games. Children in the experimental group showed significant decreases in BMI whereas the control group did not. Robinson reports also "statistically significant decreases in children's reported television viewing and meals eaten in front of the television."

A second study[12] corroborated the effect of reducing television viewing time in order to reduce of risk for obesity. These investigators observed an increased rate of obesity remission among adolescents who concurrently decreased the number of hours spent watching television. "We observed a strong dose-response relationship between the prevalence of overweight in 1990 and hours of television viewed."

Finally, an investigation done in Santa Barbara, Calif., schools[13] reported on obesity in sixth- and seventh-grade students and showed a statistically significant association between hours of television viewing per evening and obesity as per their definition (95th percentile and above).

The association between television viewing and adolescent obesity has also been reported in other countries, notably China[14] and Greece[15]. These studies suggest that television viewing transcends cultural differences as a primary risk factor for adolescent obesity. Ma reports that among 9,356 surveyed Chinese adolescents, "each hourly increment of television viewing was associated with 1%-2% increase in the prevalence of obesity," concluding that "…time spent watching television is directly related to an increased risk of obesity…" Krassas found in a cross-sectional study of 2,495 children aged 6-17 years that the risk of obesity among adolescents is positively influenced by the number of hours spent per day watching television and playing video games.

Not all studies reported statistically significant associations between television viewing and adolescent obesity. For example, Patrick[16] studied 878 adolescent males and females aged 11-15 years. While they reported that overweight or at-risk boys "watched more minutes per day of television on non-school days than normal-weight boys," only "insufficient vigorous physical activity" was statistically associated with 'at risk' and overweight among adolescents. A second study[17] failed to detect significant associations between television viewing and adolescent obesity risk after controlling for SES and ethnicity, suggesting that the strength of the relationship between television viewing and adolescent obesity is modified by cultural factors, such as income level and ethnicity.

METHODS

Sample

Data were obtained from the 2001 YRBS, a nationally representative survey (n=13,667) developed and implemented by the Centers for Disease Control and Prevention (CDC) in order to assess the health status of adolescents. The actual response data are available from the CDC website, at http://www.cdc.gov/HealthyYouth/yrbs/index.htm. The privacy of respondents is protected through voluntary and anonymous participation. The YRBS is a probabilistic, multistage cluster sample of American children in grades 9-12.

A weighting factor is assigned to each YRBS respondent to adjust for non-response and the multistage sampling design. Therefore, all analyses conducted in this assessment were done using SAS (proc surveylogistic, proc surveymeans, proc surveyfreq) to account for the complex sampling and weighting design of the YRBS. Self-reported heights and weights were converted to body mass indices (BMI) according to age and gender. Subjects were considered obese when BMI was in the 95th percentile or above. BMIs below the 95th percentile were considered non-obese. According to Brener, et al[18], self-reported height and weight are highly reliable even though they differ from measured values.

Statistical Methods

SAS was used to estimate both the odds ratio and the corresponding 95% confidence interval. Controlling for age and ethnicity, risk of obesity is measured as an adjusted odds ratio for increasing amounts of self-reported television viewing on an average school day. Demographic and anthropometric characteristics were determined based on the following survey questions:

- *How old are you?*
- *What is your sex?*
- *How do you describe yourself?*
- *How tall are you without your shoes on? (Note: Data are in meters.)*
- *How much do you weigh without your shoes on? (Note: Data are in kilograms.)*
- *On an average school day, how many hours do you watch TV?*

Two logistic models were estimated in this assessment, one for females and one for males. Such gender differences in normal and aberrant BMI are important considerations in risk assessments of this type. The dependent (or outcome) variable was based on the respondents' BMI; 1=95th percentile or higher, 0=otherwise. The independent variable was specified as self-reported time spent viewing television on

Table 1. Demographic and Anthropometric Characteristics of Study Sample. 2001 Youth Risk Behavior Survey

Characteristic	Female		Male		
	n	Percent	n	Percent	Total
Age					
12 years old or younger	2	39.2%	4	73.9%	6
13 years old	8	64.7%	5	41.9%	12
14 years old	869	58.6%	614	41.4%	1482
15 years old	1850	53.4%	1613	46.6%	3463
16 years old	1792	50.4%	1761	49.6%	3553
17 years old	1578	49.9%	1582	50.1%	3160
18 years old or older	850	45.3%	1026	54.7%	1876
Missing					115
Total	6950	50.9%	6605	48.3%	13667
Race/Ethnicity					
Am Indian / Alaska Native	46	48.5%	48	51.5%	94
Asian	230	50.7%	223	49.3%	453
Black or African American	891	51.1%	852	48.9%	1743
Hispanic or Latino	694	50.1%	690	49.9%	1384
Native Hawaiian/other PI	49	49.4%	51	51.6%	99
White	4646	51.2%	4430	48.8%	9076
Multiple - Hispanic	122	55.6%	98	44.8%	219
Multiple - Non-hispanic	202	55.1%	164	44.9%	366
Missing					233
Total	6878	50.3%	6558	48.0%	13667
TV Watching					
No TV on average school day	535	58.9%	374	41.2%	908
Less than 1 hour per day	1181	57.0%	890	43.0%	2071
1 hour per day	1119	53.5%	973	46.5%	2092
2 hours per day	1589	51.3%	1508	48.7%	3097
3 hours per day	1105	48.3%	1185	51.7%	2290
4 hours per day	588	47.3%	655	52.7%	1242
5 or more hours per day	690	45.0%	845	55.1%	1534
Missing					433
Total	6806	49.8%	6430	47.0%	13667
Weight Classification					
Obese	322	48.1%	348	52.0%	669
Non-obese	6571	51.2%	6254	48.8%	12825
Missing					173
Total	6893	50.4%	6602	48.3%	13667
Height (meters) (standard error)		1.64(±0.001)		1.77(±0.001)	1.70(±0.002)
Weight (kilograms) (standard error)		59.84(±0.25)		73.44(±0.30)	66.47(±0.30)
BMI (standard error) *		22.21(±0.08)		23.50(±0.09)	22.83(±0.08)

*Body Mass Index (BMI)= weight in kilograms / height in meters^2

Table 2. Adjusted and Unadjusted Odds Ratios by Gender and Age with 95% Confidence Intervals

Age	Female		Male	
	Unadjusted OR	Adjusted OR	Unadjusted OR	Adjusted OR
12 years old or younger	3.50 (0.66, 18.41)	1.29 (0.23, 7.21)	<0.001 (<0.001, <0.001)	<0.001 (<0.001, <0.001)
13 years old	<0.001 (<0.001, <0.001)	<0.001 (<0.001, <0.001)	0.32 (0.04, 2.60)	0.29 (0.03, 2.56)
14 years old	0.56 (0.32, 0.96)*	0.46 (0.26, 0.80)*	0.34 (0.18, 0.67*)	0.27 (0.13, 0.54)*
15 years old	0.50 (0.30, 0.83)*	0.43 (0.25, 0.71)*	0.67 (0.40, 1.11)	0.59 (0.34, 1.01)
16 years old	0.81 (0.53, 1.24)	0.74 (0.48, 1.15)	0.69 (0.46, 1.03)	0.63 (0.42, 0.95)*
17 years old	0.71 (0.44, 1.13)	0.68 (0.42, 1.10)	0.60 (0.40, 0.91)*	0.59 (0.39, 0.91)*
18 years	1.00	1.00	1.00	1.00

*$p<0.05$

Table 3. Adjusted and Unadjusted Odds Ratios by Gender and Race/ethnicity with 95% Confidence Intervals

Race/ethnicity	Female		Male	
	Unadjusted OR	Adjusted OR	Unadjusted OR	Adjusted OR
Am Indian / Alaska Native	1.53 (0.69, 3.39)	1.37 (0.60, 3.09)	1.34 (0.39, 4.62)	1.28 (0.37, 4.41)
Asian	0.31 (0.07, 1.42)	0.30 (0.07, 1.30)	0.23 (0.05, 1.05)	0.25 (0.06, 1.11)
Black or African American	3.23 (2.07, 5.03)*	2.43 (1.48, 4.0)*	1.77 (1.28, 2.45)*	1.47 (1.07, 2.02)*
Hispanic or Latino	1.53 (1.00, 2.34)	1.39 (0.93, 2.09)	1.50 (0.92, 2.43)	1.42 (0.88, 2.29)
Multiple - Hispanic	2.23 (1.11, 4.46)*	2.11 (1.05, 4.24)*	2.09 (0.81, 5.37)	2.22 (0.84, 5.91)
Multiple - Non-hispanic	1.44 (0.53, 3.94)	1.30 (0.43, 3.91)	1.37 (0.65, 2.89)	1.32 (0.58, 2.98)
Native Hawaiian/other PI	0.69 (0.09, 5.44)	0.61 (0.08, 4.60)	1.43 (0.60, 3.42)	1.13 (0.44, 2.86)
White	1.00	1.00	1.00	1.00

*$p<0.05$

Table 4. Adjusted and Unadjusted Odds Ratios by Gender and Hours of Viewing Television with 95% Confidence Intervals

Television viewing	Female		Male	
	Unadjusted OR	Adjusted OR	Unadjusted OR	Adjusted OR
1 hour per day	0.69 (0.39, 1.24)	0.72 (0.40, 1.29)	0.89 (0.43, 1.8)	0.93 (0.45, 1.90)
2 hours per day	1.21 (0.68, 2.18)	1.23 (0.67, 2.25)	1.35 (0.83, 2.21)	1.37 (0.82, 2.29)
3 hours per day	1.76 (1.15, 2.69)*	1.59 (1.03, 2.47)*	1.47 (0.75, 2.88)	1.51 (0.76, 3.03)
4 hours per day	1.82 (0.96, 3.48)	1.61 (0.87, 2.99)	1.74 (0.95, 3.18)	1.71 (0.91, 3.2)
5 or more hours per day	2.81 (1.71, 4.62*)	1.95 (1.13, 3.36)*	2.31 (1.21, 4.41)*	2.25 (1.16, 4.38)*
Less than 1 hour per day	1.01 (0.54, 1.88)	1.01 (0.53, 1.92)	0.68 (0.38, 1.21)	0.70 (0.39, 1.27)
No hours per day	1.00	1.00	1.00	1.00

*$p<0.05$

an average school day. Covariates included age and race/ethnicity. Both dependent and independent variables were coded as binary variables, 1 or 0. SAS software, which accommodates the complex weighting design of the survey, provided estimates of variances (with standard error) and odds ratios (with 95% confidence intervals).

RESULTS

A response rate of 63% was attained during the administration of the 2001 YRBS, based on participating school districts and individual students. Of the 13,667 respondents who participated in the 2001 YRBS, 6,950 (50.9%) were female and 6,605 (48.3%) were male. The mean height for females and males respectively is 1.64(±0.001) and

Figure 1. Adjusted Odds Ratios with 95% Confidence Intervals for Obesity in Association with Television Viewing Among Females

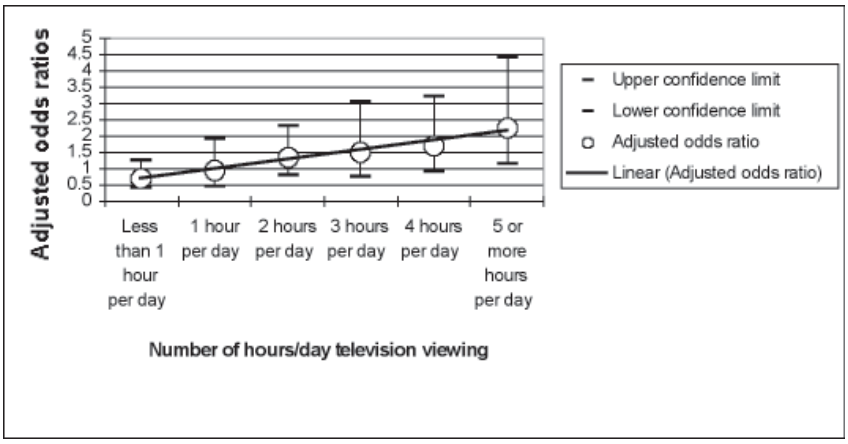
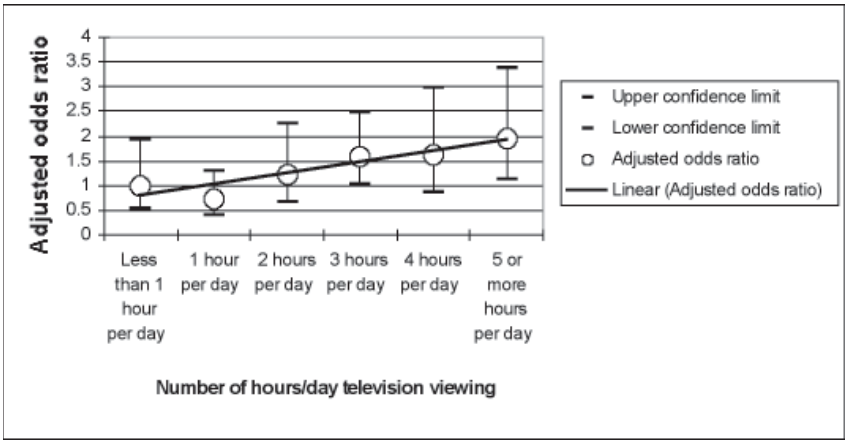


Figure 2. Adjusted Odds Ratios with 95% Confidence Intervals for Obesity in Association with Television Viewing Among Males



1.77 (±0.001); the mean weight for females and males respectively is 59.84 (± 0.25), 73.44 (± 0.30); and the mean BMI for females is 22.21 (± 0.08) and for males is 23.50 (± 0.09) (Table 1).Table 2 shows adjusted and unadjusted odds ratios for obesity for both male and female subjects by age. Eighteen-year-old subjects were selected as the reference group with an odds ratio of 1.00. Females ages 14 and 15 years had adjusted odds ratios of 0.46 and 0.43 respectively, both of which were significantly lower than the referent group (18 year olds). Fourteen-, sixteen- and seventeen-year-old males had odds ratios of 0.27, 0.63 and 0.59, respectively. All of these are significantly lower than the reference group ($p<.05$).

These findings are consistent with adolescent growth patterns during which disproportionate increases in either height or mass may occur. For this reason, age is an appropriate covariable among adolescents for testing the impact of other risks (i.e., television viewing) on obesity.

Table 3 shows adjusted odds ratios for both male and female subjects by race/ethnicity. White subjects were the reference group with an odds ratio of 1.00. Odds ratios for African-American females and multiple Hispanic females were significantly higher than standard risk at 2.43 and 2.10, respectively. African American males show significantly elevated risk of obesity with an odds ratio of 1.47. No other significant associations among race/ethnicity and obesity risk were evident.

Table 4 shows odds ratios for obesity by hours of television per average school day by sex. Subjects who reported no television viewing on an average school day served as reference-risk with an odds ratio of 1.0.

For females, significant elevations in obesity risk were observed at 3 hours/day and at 5 hours/day, odds ratios being 1.59 (95% CI 1.03, 2.47) and 1.95 (95% CI 1.13, 3.36), respectively. We observed significantly elevated risk for obesity (AOR 2.25, 95% CI 1.16, 4.38) among males viewing five (5) or more hours per day of television. Consistent with previously reported data[1], Figures 1 and 2 suggest a dose-related, linear relationship between increasing television viewing and the increasing risk of obesity.

DISCUSSION

As adolescent obesity increases, so do the concomitant, health-related consequences. The YRBS attained a response rate of 63% for 2001. Notwithstanding the limitations of this study—63% response rate, self-reported responses and cross-sectional rather than longitudinal data—sampling methodology has benefited by serial refinement over many years, and the data set is large and representative of the nation. In defense of such health behavioral risk survey data, self-reporting may be the most reliable and cost-effective means of generating large, representative datasets. Even in consideration of these limitations, the magnitude of the risk observed among these respondents is certainly compelling. Therefore, the prominent message of this study is that television viewing is a major risk factor for obesity among both sexes, even when age and race are controlled. In addition, Figures 1 and 2 suggest the dose-response linearity between behavior and risk as reported elsewhere. Specifically, this linear pattern was

previously reported in children ages 10-15 years, and in children ages 6-17 years.

Again, the unique contribution of this assessment is that it is based on estimates drawn from a nationally representative sample, and is therefore generalizable.

Television viewing seems to be an eminently modifiable behavior and therefore rife with potential for change. This behavior is nonetheless complex. It is tempting to ascribe the risks of television viewing exclusively to its inherent torpor: the setting is comfortable, the posture is relaxed, and the metabolism is sleep-like.

Inactivity, while accurately considered a major contributor to overweight, is but part of the overall obesity problem that can be linked to television viewing. There may also be eating behaviors associated with television viewing that compound its effect by promoting increased caloric intake. Viewers encounter greater numbers of sponsors in direct proportion to time spent viewing. Many sponsors represent calorie-dense, nutritionally sparse products. The effects of such advertisement can only be speculated upon at this point. Further study documenting the impact of television-mediated advertising on adolescent eating behaviors is clearly warranted.

CONCLUSION

Health educators interpret relevant research that can effectively be integrated into pedagogic interventions. It could be proposed that television viewing represents a modifiable behavior with strong associations to obesity. However, television viewing among adolescents may be no easier to modify than other health-related behaviors, such as smoking, unprotected sex, alcohol use, etc. Nonetheless, the impact that television viewing appears to have on adolescent obesity risk makes such behavior a strong candidate for future interventions aimed at reducing obesity among 'at risk' groups. We found reported evidence from at least one intervention in which television viewing reductions were effective in decreasing obesity in targeted adolescents. Analysis of the 2001 YRBS reveals a significant increased in risk of obesity ($p<0.05$) as daily television viewing reaches five (5) hours/day or more in male and female Americans aged 12-18. This association is independent of age, sex and race. Inasmuch as television viewing is a modifiable behavior, we see potential for intervention and risk reduction.

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